

WHAT IS CLAIMED IS:

1. An assembly comprising:
  - a substrate,
  - an integrated circuit device adapted to be electrically and mechanically connected to the substrate,
    - 5 electrical connection pads on the integrated circuit device and on the substrate adapted to contact one another when the circuit device and the substrate are connected, said connection pads comprising at least one first projection on one of the device and the substrate and at least two second projections on the other of the device and the substrate, each projection having a respective axial length extending from an external surface of a respective connection pad,
      - 10 the at least one first projection and at least two second projections having respective external surfaces that are sized and shaped for a close friction fit along their axial lengths when interdigitated relative to one another thereby to create an axial contact area between respective projections to establish an electrical and mechanical connection between the device and the substrate.
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  2. An assembly as set forth in claim 1 wherein said at least one first projection is on the integrated circuit device and said at least two second projections are on the substrate.
  3. An assembly as set forth in claim 1 wherein said at least one first projection comprises a headless projection.
  4. An assembly as set forth in claim 1 wherein said at least one first projection comprises a solid cylindrical body.
  5. An assembly as set forth in claim 1 wherein said at least one first projection is substantially rigid.

6. An assembly as set forth in claim 4 wherein said body is formed integral with said one of the circuit device or substrate.

7. An assembly as set forth in claim 6 wherein said body comprises a metal external surface for contacting said at least two second projections.

8. An assembly as set forth in claim 4 wherein said at least two second projections comprise solid cylindrical bodies and are spaced apart to form an open space for receiving said at least one first projection.

9. An assembly as set forth in claim 8 wherein said solid cylindrical bodies of the first and second projections are substantially rigid.

10. An assembly as set forth in claim 8 wherein said second projections have metal external surfaces for contact with said body of the at least one first projection.

11. An assembly as set forth in claim 1 wherein said at least one first projection comprises a frustum-shaped body.

12. An assembly as set forth in claim 1 wherein said at least one first projection and said at least two second projections have elliptical cross-sections.

13. An assembly as set forth in claim 1 wherein said at least one first projection and said plurality of second projections have polygonal cross-sections.

14. An assembly as set forth in claim 1 wherein said integrated circuit device is a MEMS device.

15. An assembly as set forth in claim 1 wherein said integrated circuit device is an optical MEMS device.

16. An assembly as set forth in claim 1 wherein said substrate is a chip carrier platform.

17. An assembly as set forth in claim 1 wherein said substrate is a circuit board.

18. An assembly comprising:

a substrate having a plurality of connection pads, each pad comprising a plurality of spaced apart electrically conductive substrate projections extending from an external surface of the pads and forming an open space therebetween, each substrate projection having a respective axial length,

an integrated circuit device adapted to be electrically and mechanically connected to the substrate, said device having a plurality of connection pads, each pad comprising at least one electrically conductive device projection extending from an external surface of the pad, each device projection having a respective axial length and being adapted for insertion into said open space such that the device and the substrate are held in electrical and mechanical connection by a friction fit between respective axial lengths of the substrate and device projections.

19. An assembly as set forth in claim 18 wherein at least one of said substrate and device projections comprises a solid cylindrical body having a metal external surface.

20. An assembly as set forth in claim 18 wherein at least one of said substrate and device projections comprises a frustum-shaped body.

21. An assembly as set forth in claim 20 wherein said frustum-shaped body comprises a head portion adapted for insertion into said open space between substrate projections.

22. An assembly as set forth in claim 18 wherein at least one of said substrate and device projections has an elliptical cross-section.

23. An assembly as set forth in claim 18 wherein at least one of said substrate and device projections has a polygonal cross-section.

24. An assembly comprising:

a substrate,

an electrical circuit device adapted to be electrically and mechanically connected to the substrate,

5 a first connection pad on the substrate comprising a first set of two or more electrically conductive connecting elements protruding from an external surface of one pad, each connecting element of the first set having an axial length generally perpendicular to the substrate,

10 a second connection pad on the circuit device comprising a second set of one or more electrically conductive connecting elements protruding from an external surface of the pad and adapted for interdigitation with the connecting elements of the first set of connecting elements, each connecting element of the second set having an axial length,

15 said first and second sets of connecting elements having respective external surfaces that are sized and shaped for a close friction fit along their axial lengths when interdigitated relative to one another thereby to create an axial contact area between respective projections to establish an electrical and mechanical connection between said device and the substrate.

25. An assembly as set forth in claim 24 wherein said second set of electrically conductive connecting elements comprises a solid cylindrical body having a metal external surface.

26. An assembly as set forth in claim 24 wherein said second set of electrically conductive connecting elements comprises a frustum-shaped body extending from the second connection pad.

27. An assembly as set forth in claim 24 wherein said second set of electrically conductive connecting elements have elliptical cross-sections.

28. An assembly as set forth in claim 24 wherein said second set of electrically conductive connecting elements have polygonal cross-sections.

29. A integrated circuit device package comprising:  
an integrated circuit device having an active side with at least one electrical connection pad thereon;  
an interconnect substrate for mounting said integrated circuit device on an electronic circuit substrate, said interconnect substrate having a first side adapted to mate with the active side of the integrated circuit device to form an enclosed space and a second side adapted for electrical and mechanical connection to the electronic circuit substrate,  
the interconnect substrate having at least one set of electrical connection pads, each set comprising a first electrical connection pad on the first side of the interconnect substrate adapted for electrical connection to the at least one electrical connection pad on the integrated circuit device and a second electrical connection pad on the second side of the interconnect substrate electrically connected to the first connection pad, said second electrical connection pad on the second side of the interconnect substrate being adapted for electrical and mechanical connection to the electronic circuit substrate.

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30. A package as set forth in claim 29 wherein said second electrical connection pad on the interconnect substrate comprises at least one electrical conductive connecting element for connection to the electronic circuit substrate.

31. A package as set forth in claim 30 wherein said at least one electrical conductive connecting element comprises a solder ball for electrical and mechanical connection to the electronic circuit substrate.

32. A package as set forth in claim 30 wherein said at least one electrical conductive connecting element comprise a projection extending from an external surface of the second electrical connection pad.

33. A package as set forth in claim 32 wherein said projection comprises a solid cylindrical body.

34. A package as set forth in claim 32 wherein said projection is substantially rigid.

35. A package as set forth in claim 33 wherein said body is formed integral with said interconnect substrate.

36. A package as set forth in claim 30 further comprising at least two electrical conductive connecting elements on the electronic circuit substrate adapted to mate with said at least one electrical conductive connecting element on the interconnect substrate.

37. A package as set forth in claim 36 wherein said electrical conductive connecting elements on the electronic circuit substrate and on the interconnect substrate are sized and shaped for a close interdigitated friction fit relative to one another thereby to establish an electrical and mechanical connection between the package and the electronic circuit substrate.

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38. A package as set forth in claim 29 wherein said interconnect substrate comprises an electrically conductive via that electrically connects said first and second electrical connection pads on the interconnect substrate.

39. A package as set forth in claim 29 wherein said first electrical connection pad on the interconnect substrate comprises at least one protrusion adapted for contact with said integrated circuit device electrical connection pad.

40. A package as set forth in claim 29 wherein said first electrical connection pad on the interconnect substrate comprises at least one spring adapted to contact the integrated circuit device electrical connection pad.

41. A package as set forth in claim 29 wherein said interconnect substrate and said integrated circuit device are approximately equal size.

42. A package as set forth in claim 29 wherein said integrated circuit device is a MEMS device.

43. A package as set forth in claim 29 wherein said interconnect substrate is translucent.

44. A package as set forth in claim 43 wherein said integrated circuit device is an optical MEMS device.

45. A package as set forth in claim 29 wherein said electronic circuit substrate is a circuit board.

46. A package as set forth in claim 29 wherein said first side of said interconnect substrate comprises an outer rim for sealing contact with said integrated circuit device.

47. A package as set forth in claim 46 wherein said first side of said interconnect substrate further comprises a recess that forms said enclosed space upon contact of said outer rim with said integrated circuit device.

48. A package as set forth in claim 47 wherein said first side of said interconnect substrate further comprises a shoulder between the recess and the outer rim for placement of the first electrical connection pad of the interconnect substrate.

49. A process for forming an integrated circuit device package, the process comprising the steps of:

fabricating an integrated circuit device wafer having an active side;

fabricating an interconnect substrate wafer such that said wafer has electrical connection pads on opposite sides thereof and a recessed surface;

electrically and mechanically connecting the integrated circuit device wafer and interconnect substrate wafer such that the two wafers form an enclosed space between the active side of said integrated circuit device wafer and the recessed surface of the interconnect substrate wafer; and

10 dicing the integrated circuit device wafer and interconnect substrate wafer to form one or more individual integrated circuit device packages.

50. The process as set forth in claim 49 wherein said fabricating an interconnect substrate wafer step includes configuring the interconnect substrate wafer to have at least one electrical conductive connecting element for electrical and mechanical connection to an electronic circuit substrate.

51. The process as set forth in claim 49 wherein said dicing step comprises cutting the joined wafers into said one or more individual integrated circuit device packages.

52. An interconnect substrate for mounting an integrated circuit device on an electronic circuit substrate, said interconnect substrate comprising:

a first side adapted to mate with an active side of the integrated circuit device to form an enclosed space and a second side adapted for electrical and mechanical connection to the electronic substrate,

5 a first electrical connection pad on the first side of the interconnect substrate adapted for electrical connection to the integrated circuit device, and

10 a second electrical connection pad on the second side of the interconnect substrate electrically connected to the first connection pad, said second electrical connection pad on the second side of the interconnect substrate being adapted for electrical and mechanical connection to the electronic circuit substrate.

53. An interconnect substrate as set forth in claim 52 wherein said first side of said interconnect substrate comprises an outer rim for sealing contact with said integrated circuit device.

54. An interconnect substrate as set forth in claim 53 wherein said first side of said interconnect substrate further comprises a recess that forms said enclosed space upon contact of said outer rim with said integrated circuit device.

55. An interconnect substrate as set forth in claim 53 wherein said first side of said interconnect substrate further comprises a shoulder between the recess and the outer rim for placement of the first electrical connection pad.

56. An interconnect substrate as set forth in claim 52 further comprising an electrically conductive via that electrically connects said first and second electrical connection pad.

57. An interconnect substrate as set forth in claim 52 wherein said first electrical connection pad comprises at least one protrusion adapted for contact with an electrical connection pad on the integrated circuit device.

58. An interconnect substrate as set forth in claim 52 wherein said first electrical connection pad comprises at least one spring adapted for contact with an electrical connection pad on the integrated circuit device.